UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/682,154	10/10/2003	Saichirou Kaneko	50195-391	8202

7590 01/27/2006

McDERMOTT, WILL & EMERY
600 13th Street, N.W.
Washington, DC 20005-3096

EXAMINER	
DICKEY, THOMAS L	
ART UNIT	**PAPER NUMBER**
2826	

DATE MAILED: 01/27/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	**Application No.** 10/682,154	**Applicant(s)** KANEKO ET AL.	
	Examiner Thomas L. Dickey	**Art Unit** 2826	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *13 December 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1 and 4-23* is/are pending in the application.

4a) Of the above claim(s) *4-7 and 10-19* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,8,9 and 20-23* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *10 October 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 10/31/2005 has been entered.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless --
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1,8,9, and 20-23 are rejected under 35 U.S.C. 102(b) as being anticipated by TERASAWA (6,002,143).

A. With regard to claim 23 the embodiment of Terasawa shown in figure 7 discloses a tunnel-injection device having source 17 and drain 18 electrodes, comprising:

(1) Means for forming a heterojunction interface so as to generate a band-edge discontinuity barrier for a tunneling injection of carriers at the heterojunction interface.

The examiner finds that this limitation invokes 35 USC 112 paragraph 6. This finding is based on the facts that this limitation recites "means for," the recited "means for" is modified by functional language, to wit, "forming a heterojunction interface so as to generate a band-edge discontinuity barrier for a tunneling injection of carriers at the heterojunction interface," and that the recited "means for" is not modified by any structural language whatever. The invocation of Paragraph 6 means that this recitation claims corresponding structure (the claimed "means for" being part of a device, only structure may be claimed) identified in Applicants' specification, and equivalents thereof.

Applicant identifies the following structure as being capable of forming a heterojunction interface so as to generate a band-edge discontinuity barrier for a tunneling injection of carriers at the heterojunction interface: The interface between "reception layer" 20 (note that in paragraph 55 Applicant explains that the "reception layer" is an n^- type SiC drift layer) and "barrier forming layer" 60 (note that in paragraph 60 Applicant identifies "barrier forming layer" 60 as a p type polysilicon film). Note paragraph 52 and figure 1 of the instant application. The identical structure may be found in Terasawa at the interface between Terasawa's n^- type SiC drift layer 12 and Terasawa's p type polysilicon film 13. Note figure 1 and column 5 lines 31-36 of Terasawa.

(2) Means for supplying carriers so as to accumulate the carriers at the heterojunction interface, being contacted with the source electrode.

The examiner finds that this limitation invokes 35 USC 112 paragraph 6. This finding is based on the facts that this limitation recites "means for," the recited "means for" is modified by functional language, to wit, "supplying carriers so as to accumulate the carriers at the heterojunction interface, being contacted with the source electrode," and that the recited "means for" is not modified by any structural language whatever. The invocation of Paragraph 6 means that this recitation claims corresponding structure (the claimed "means for" being part of a device, only structure may be claimed) identified in Applicants' specification, and equivalents thereof.

Applicant identifies the following structure as being capable of supplying carriers so as to accumulate the carriers at the heterojunction interface, being contacted with the source electrode: "a plurality of carrier-supplying regions 18 being contact with the corresponding barrier-forming layers 60." Note paragraph 53 and figure 1 of the instant application. The identical structure may be found in Terasawa in the source regions 16, which is contacted with source electrode 17. Note figure 1 and column 5 lines 44 and 50 of Terasawa.

(3) Means for applying an electric field to the band-edge discontinuity barrier, the electric field controls a width of the band-edge discontinuity barrier so as to change the tunneling probability of the carriers, which are configured to be injected by tunneling through the band-edge discontinuity barrier.

The examiner finds that this limitation invokes 35 USC 112 paragraph 6. This finding is based on the facts that this limitation recites "means for," the recited "means for" is modified by functional language, to wit, "applying an electric field to the band-edge discontinuity barrier, the electric field controls a width of the band-edge discontinuity barrier so as to change the tunneling probability of the carriers, which are configured to be injected by tunneling through the band-edge discontinuity barrier," and that the recited "means for" is not modified by any structural language whatever. The invocation of Paragraph 6 means that this recitation claims corresponding structure (the claimed "means for" being part of a device, only structure may be claimed) identified in Applicants' specification, and equivalents thereof.

Applicant identifies the following structure as being capable of applying an electric field to the band-edge discontinuity barrier, the electric field controls a width of the band-edge discontinuity barrier so as to change the tunneling probability of the carriers, which are configured to be injected by tunneling through the band-edge discontinuity barrier: "a plurality of gate electrodes 40 disposed on corresponding gate insulating films 30 configured to control the width of the barrier generated at the interface between the reception layer 20 and the barrier-forming layer 60 so as to change the tunneling probability of carriers through the barrier." Note paragraph 52 and figure 1 of the instant application. The identical structure may be found in Terasawa in gate electrodes 15 formed on insulating films 14. Note figure 1 and column 5 lines 43 and 44 of Terasawa.

(4) Means for receiving carriers injected by tunneling through the band-edge discontinuity barrier, being contacted with the drain electrode. Note figure 7, column 9 lines 50-67, and column 10 lines 1-9 of Terasawa.

The examiner finds that this limitation invokes 35 USC 112 paragraph 6. This finding is based on the facts that this limitation recites "means for," the recited "means for" is modified by functional language, to wit, "receiving carriers injected by tunneling through the band-edge discontinuity barrier, being contacted with the drain electrode," and that the recited "means for" is not modified by any structural language whatever. The invocation of Paragraph 6 means that this recitation claims corresponding structure (the claimed "means for" being part of a device, only structure may be claimed) identified in Applicants' specification, and equivalents thereof.

Applicant identifies the following structure as being capable of receiving carriers injected by tunneling through the band-edge discontinuity barrier, being contacted with the drain electrode: "a carrier receiving region 10 being contact with the reception layer 20, configured to receive the carriers injected by tunneling through the barrier." Note paragraph 53 and figure 1 of the instant application. Applicant goes on to identify receiving region 10 as an n^+ SiC substrate in contact with drain electrode 90. Note paragraph 55 of the instant application. The identical structure may be found in Terasawa in n^+ SiC substrate 11 in contact with drain electrode 18. Note figure 1 and column 5 lines 28, 29, 50, and 51 of Terasawa.

B. With regard to claims 1,8,9,21, and 22 the embodiment of Terasawa shown in figure 1 discloses a tunnel-injection device, comprising a reception layer (i.e. drift region) 12 made of a first semiconductor (SiC); a barrier-forming layer 13 made of a second semiconductor (silicon) having a bandgap narrower than the first semiconductor (SiC), being in metallurgical contact with the reception layer 12 so as to form a barrier (recognizable as the difference between the small Si bandgap and the wide SiC bandgap) at a heterojunction (i.e. between two different materials, in this case SiC and Si) interface between the first (SiC) and the second (Si) semiconductors; a gate insulating film 14 disposed on the barrier-forming layer 13 contacting to the heterojunction interface; a gate electrode 15 disposed on the gate insulating film 14; a drain region 11 made of the first semiconductor (SiC), being contacted with the reception layer 12, configured to receive the carriers injected by tunneling through the barrier; a carrier-supplying (i.e. source) region 16 made of the second semiconductor (silicon), being contacted with the barrier-forming layer 13, configured to supply the carriers to the barrier-forming layer 13: and a source electrode 17 being contacted with the carrier-supplying region 16, wherein the carrier-supplying region 16 and the barrier-forming layer 13 are laminated on the top surface of the reception layer 12, in a substantially same planar level and the gate insulating film 14 contacts with the top surface of the reception layer 12 in a window part of the barrier-forming layer 13 being laminated on the top surface of the reception layer 12, and wherein the first semiconductor (SiC) is made of SiC and the second semiconductor (silicon) is selected from the group consisting of single crystalline silicon, polysilicon and amorphous silicon. Note figure 1 and column 5 lines 22-60 of Terasawa.

The applicant's claims 1,8,9,21, and 22 do not distinguish over the Terasawa reference regardless of the functions allegedly performed by the claimed device, because only the structure of said device per se is relevant, not the recited functions of the barrier at the heterojunction interface tunneling injection of carriers, the gate electrode changing a tunneling probability of the carriers by controlling a width of the barrier or the limitation that these self-same carriers being injected into the reception layer by tunneling.

Note that functional language in a device claim is directed to the device per se, no matter which of the device's functions is referred to in the claim. See *In re Ludtke and Sloan*, 169 USPQ 563 at 567, and *In re Swinehart* 169 USPQ 226, both of which make it clear that it is the patentability of the device per se which must be determined in a "functional language" claim and not the patentability of the function, and that an old or obvious device alleged to perform a new function is not patentable as a device, whether claimed in "functional language" claims or not. Note that applicant has the burden of proof in such cases, as the above caselaw makes clear. See also In re Schreiber, 44 USPQ2d 1429, 1432 (Fed. Cir. 1997), for a discussion of the roles of examiner and applicant in determining when and how functional limitations distinguish a claim from prior art disclosing the same structure.

C. With regard to claim 20 the embodiment of Terasawa shown in figures 6a-6f discloses a method for fabricating a tunnel-injection device, comprising preparing a base body (aka drift region, or, as applicant sometimes refers to it elsewhere, "reception layer") 12 made of a first semiconductor (SiC); growing a layer 13 (as seen in figure 6B) made of a second semiconductor (silicon) having a bandgap narrower than the first semiconductor (SiC) on a surface of the base body (aka drift region) 12 so as to form a barrier (recognizable as the difference between the small Si bandgap and the wide SiC bandgap) at a heterojunction (i.e. between two different materials, in this case SiC and Si) interface between the first (SiC) and the second (Si) semiconductors; doping first impurity (p-type) atoms in the layer 13 so as to form a barrier-forming layer 13 made of the second semiconductor (silicon); doping selectively second impurity (n-type) atoms with heavier doping level than the barrier-forming layer 13 so as to form a carrier-supplying (i.e. source) region 16, made of the second semiconductor (silicon) configured to supply carriers to the barrier-forming layer 13; depositing a gate insulating film 14 on the barrier-forming layer 13 so as to contact with the heterojunction interface; forming a gate electrode 15 on the gate insulating film 14; and forming a source electrode 17 on the carrier-supplying region. Note figures 6a-6f, column 8 lines 60-67, and column 9 lines 1-49 of Terasawa.

The applicant's claim 20 does not distinguish over the Terasawa reference regardless of the functions allegedly performed by the device made by the claimed process, because only the limitations placed on the process by the structure of said device per se is relevant, not the recited functions of the barrier made by the process at the heterojunction interface tunneling injection of carriers, the gate electrode made by the process changing a tunneling probability of the carriers by controlling a width of the barrier or the limitation of these self-same carriers (which are elementary particles not created by the claimed process) being injected into the reception layer by tunneling.

Functional language in a device claim is directed to the device per se, no matter which of the device's functions is referred to in the claim. See *In re Ludtke and Sloan*, 169 USPQ 563 at 567, and *In re Swinehart* 169 USPQ 226, both of which make it clear that it is the patentability of the device per se which must be determined in a "functional language" claim and not the patentability of the function, and that an old or obvious device alleged to perform a new function is not patentable as a device, whether claimed in "functional language" claims or not. Note that applicant has the burden of proof in such cases, as the above caselaw makes clear. In claim 20, the device is claimed not as a device but as a requirement that the claimed process ultimately produce a device having a particular structure. Since the limitation, although applied to a process claim, is ultimately structural, the Swinehart holding still applies.

Response to Arguments

4. Applicant's arguments with respect to claims 1,8,9, and 20-23 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thomas L. Dickey whose telephone number is 571-272-1913. The examiner can normally be reached on Monday-Thursday 8-6.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan J. Flynn can be reached on 571-272-1915. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Thomas L. Dickey
Patent Examiner
Art Unit 2826
01/06